FISHERIES AND THE ENVIRONMENT

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Introduction

Fishing is a dangerous and unstable way to earn a living. It has a higher accident rate than any other civilian job and depends on irregular variables, prices and changes in the world's climate that are becoming harder and harder to predict.

Pollution and the weather changes predicted for the year 2025 (a rise of 1.560 in the temperature of the ocean surface and an increase of 20 cm in level of the sea) are endangering the planet. The delicate makeup of the oceans is very sensitive and will be one of the first to suffer permanent and irreversible damage. Weather changes and pollution will do devastating harm to the fishing industry and its communities.

The first signs of these changes have already appeared. Estimates of maximum sustainable yields (MSY) have been rapidly declining, and reductions in fishing quotas have affected fish-workers over the last five years. Fishery stocks are declining and abnormal shifts in the seasons and location of many species have taken place in many areas. The reductions that have been produced show that there are other variables that diminish stocks and interfere in reproductive cycles. These have not been introduced into statistical models for analysing populations. However, one thing sure is that we are paying the price for imprudent environmental behaviour, If we do not take measures now, the future of the fishing industry and fishermen will be bleak indeed.

Pollution

Thirty years ago, pollution was taken as a bother that had to be tolerated, the inevitable consequence of urban life and even a symbol of prosperity. With the development of technology and research, it has been demonstrated that its effects involve much more than aesthetic unpleasantries. Pollution has serious consequences for human health and the quality of ecosystems.

For an idea of the magnitude of environmental problems in relation to the real possibility of solving them, we have only to recall that according to data from the Environmental Protection Agency (EPA) of the United States and the World Health Organization (WHO), in 1991 there were approximately 80000 chemical substances used every day throughout the world. No more than 3000 of them have been carefully studied. Once they are released, they undergo transformations which multiply their number.

Nature has ways of purifying itself, but these are limited and can be overwhelmed. In that happens, irreversible changes take place in the environment, causing sickness, death of species and destabilization of ecosystems.

When tens of thousands of tons of industrial wastes are thrown every day into rivers and the sea, when cities are covered with heavy layers of. pollution, when forests begin to disappear because of irrational lumbering, when insects begin to change habits and become resistant, when, new plagues appear because of unsuitable use of agricultural chemicals, when land becomes exhausted, sterile or begins to turn to desert, when eating seafood becomes dangerous and strong sanitary controls are needed, then the time has arrived to urgently review the principles governing the way humankind relates to nature.

The industrialized countries produce enormous quantities of hazardous waste, turning the oceans into a potential dump. Moreover, they seek to use the sea floor of third world countries as a dump, in return for foreign currencies to pay their external debt. They want to eventually move their contaminating industries there, arguing that labour costs are too high at home and that such a move generates employment in the third world. The oceans have been treated as a "free resource" to dump any kind of waste.

The composition of waste disposed of throughout the world varies from one area to another, but ft all ends up moving, mixing with others and spreading its effects. Every kind of waste has several elements and compounds, some poisonous, others harmless, and some eventually become dangerous when they accumulate. These latter can be highly dangerous especially when they combine with other elements or compounds. There is very little knowledge about these combinations.

South-east Pacific

The south-east Pacific region extends approximately 10500 km2, from 90 LN in Panama to 570 LS at the southern tip of Chile, and includes five coastal states: Colombia, Chile, Ecuador, Panama and Peru. The continental area covers 3520842 km2 and the sea area 5145000 km2 (Gallardo, 1984). There are many population centres throughout the region. The five countries have some 74 million inhabitants. By the year 2000, the population is estimated to reach 104 million, with an annual growth rate of 2.4%.

The United Nations Regional Seas Programme, through the Permanent Commission of the South Pacific, and the Plan of Action for the Protection of the Marine Environment and Coastal Areas of the South Pacific have gathered basic information on the regional distribution, dispersion and dilution of petroleum hydrocarbons, the occurrence of tar on coastlines, contents of heavy metals in the water, marine sediments and organisms and an inventory of sources of pollution.

On the basis of information available in 1989, three diagnostic analyses were done: for contamination by heavy metals, bacteria and eutrophication (Gutierrez, 1989); petroleum hydrocarbons (Ramorino, 1989), and land-based sources of pollution (Cabrera, 1989) which show the state of the environment for its multitude of users and/ or resident organisms. Studies have also been done on climatic changes and their effects on land-based coastal ecosystems (forests, grasslands, hydrographic basins), marine ecosystems (coral reefs, mangroves, pelagic coasts, benthos, estuaries), and on the fisheries of the region (PCSP, 1990). These studies took as a reference the changes produced by the "Nino" current, which gave a short-term view of the size of the problem.

With these elements, the present and future situation available to fishworkers in the south-east Pacific can be seen, if the current complacency about the pollution that is already affecting us continues unabated. After 1813 tests on pesticides, it has been found in water the presence of eight compounds. For 1474 analyses, the same eight pesticides were reported in water, with the exception of two. Studies on organisms based on 489 analyses in 28 species of fish, 9 crustaceans and 3 mollusks revealed 14 pesticides.

Eutrophication pollution in the coastal areas of the five countries is serious. It is caused by effluents from homes, industries and rivers. Bacteriologically, the sanitary state of the water is bad. There are threats of intestinal diseases such as cholera. The beaches of the region are not suitable for use, due to the presence of salmonella.

Records of pesticides found in the water show serious contamination in some areas. Pollution in sediments is moderate. For organisms, pollution is moderate in Chile and Pew and heavy in Panama. Heavy metal contamination of water for the region as a whole is worst in cadmium, moderate in chrome and, zinc, and serious for copper, iron and mercury. In sediments only mercury presents problems of serious contamination. Finally, for organisms, with some exceptions, only moderate contamination is found.

The "Niño" 1982-1983

The "Nino" current in the south-east Pacific provides us with an example of what global weather changes can do to ecosystems. Records of the "Nino" exist since 1541. Archeological records of the phenomenon date from 500 and 1100 A.D., and recent geological studies done in Ica, Pew show that similar occurrences took place up to 18 million years ago. This was shown by the existence of a round stone bank in a sequence of diatoms from that age.

The Nino is detected by the invasion of warn,, less salty water, changes in the characteristics of coastal waters, and climatic phenomena like rains, storms, variations in fog, etc. On land, the effects are landslides, run-offs into streams and rivers, erosion of river and stream beds, floods, droughts and the growth of vegetation in coastal deserts. Fish and sea birds die, ecological disasters take place, species disappear and others develop rapidly (Teves, 1990). In general, the socioeconomic effects, especially in Ecuador, Peru and Chile, have been disastrous.

This is a large-scale ocean phenomenon of the interaction between the ocean and the atmosphere. The equatorial sea responds to fluctuations in atmospheric pressure and wind patterns. Equatorial winds die and those in the central Pacific suddenly rise. This produces effects in Kelvin waves that move south down the coast of Ecuador, reaching the Chilean coast in two to three months. Kelvin waves have a double effect: eastward circulation is intensified and the thermocline is driven deeper (with maximum vertical degrees of temperature). Both effects tend to warm the surface waters of the ocean; the first by convection of western waters and the second by preventing deeper and colder water from rising to the surface, producing higher water levels along the coast.

In 1983, the abnormal warming of the South American coast was related to two different water sources: north (150N), warm surface water and low salinity, associated with the tropical waters of Panama, and South (150S), warm surface water with high salinity, associated with the advection of 'subtropical waters along the coasts (Erfen, 1984). As a result of this abnormal invasion of warm water, the surface temperature rises above normal throughout the region. The warm waters along the Peruvian coast were over 10°C above normal. The waters along the coasts of Chile and Ecuador rose 5°C above normal (Lagos, 1984: Cucalon, 1987).

The arrival of Kelvin waves to the eastern shore of the equatorial Pacific and their subsequent dissemination to the pole and along the American coast was seen in the strong deepening of the subsurface thermic structure throughout the region. As a result of these movements, the waters in Ecuador and the north of Peru had their thermocline four times deeper than usual. All the surface isotherms were above 12°C. Consequently, large subsurface thermic abnormalities were recorded, above 9°C at 50 m of depth (Lagos, 1984, op. cit; Cucalon, 1986).

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Sea level variations also reflected the vertical movements of the thermocline. In 1983, sea levels rose off the coasts of Ecuador and Peru by 30 cm to 40 cm, surpassing normal ranges. Surface temperatures rose at the level of the thermocline. To a lesser extent, sea level and the surface temperature in the eastern equatorial Pacific rose substantially. Thus the flow of heat from the ocean to the atmosphere intensified convective processes in the atmosphere, with abnormal rainfall in the south-east Pacific region.

The whole South American coast was seriously affected by torrential rains associated with an abnormal displacement of the zone of inter-tropical convergence of winds towards the south. This was a characteristic common to all the events produced by the "Nino". On the Pacific coast of Colombia, rainfall in 1983 was twice the normal rate, 40 times the in Ecuador, and 340 times in Peru (Jordan, 1984; Cucalon, 1987). Rivers rose, causing flooding that displaced earth, deepened shallow seabeds and modified terrain. Torrential rains and floods affected agriculture, dwellings, public health, school buildings, transport industry and caused the loss of human life.

Rises in the surface temperature of the ocean in the central and eastern Pacific contributed to the formation of hurricanes in places like Tahiti and Hawaii. Large tornadoes were also produced in the north-east.

These phenomena caused drastic changes in the morphology of South America. The joint action of higher sea levels and the destruction caused by large waves caused coastlines to recede, widespread flooding, erosion along the coasts, destruction of shrimp farms, mollusk beds and coastal infrastructure, and the disappearance of some fishing communities.

The economies of the countries of the region depend heavily on agriculture and fishing. Thus more knowledge about the climatic, ecological, and economic implications of the "Nino" would provide valuable guidelines for medium- and long-term economic planning for future weather changes.

Changes in the circulation of ocean and coastal currents were evident. Associated with the abrupt changes in sea level and tides that repeatedly assailed the coasts of South America, coastal currents behaved erratically. The cold waters of the Humboldt current were forced to the south. The current from the Bay of Panama was significantly intensified in the latitudes south of 15°S. (Lagos, 1984). The system of equatorial currents and the northern counter-equatorial current intensified notably; the southern equatorial current underwent reversions (Hanser, 1984).

All this contributed to the accumulation of warm water on the coast of South America and me. appearance of certain species of fish in unusual areas. For example, on the coast of Pew and the north of Chile, tropical species appeared massively. Also, deep-water species were drawn into coastal waters. Changes in the marine environment, particularly the depression in the; subsurface thermic structure, brought on alterations in the distribution and behaviour of the more important pelagic species. In this regard, vertical and horizontal migrations were reported (Jimenez and Herdson, 1984). Fishing-fleet landings, particularly in Ecuador and Peru, were drastically; reduced, to the point of totally paralyzing operations. The fishery sectors of Ecuador and Peru lost over US$ 200 million (Jordan, 1985, op.cit.).

Its impacts

Each occurrence of the Nino since 1958 has had different effects. In 1957-1958, the distribution and harvest of anchoveta were affected. In 1972-1973, the consequences were greater and longer, since the anchoveta population was drastically reduced (IMARPE, 1985 and 1987).

The lowest landing in Peru since 1959 was the one recorded in 1983 with 1 537019 metric tons. Landings in the whole region normally run between 6 to 8 million tons per year. The fishing industry lost US$ 100 million in 1983.

The most important pelagic species are anchoveta (Engraulis ringens), sardine (Sardinops sagax), horse mackerel (Trachurus murphy) and mackerel (Scomber japonicus). Harvests of these species totaled 1 404700 tons (93.5% of the catch of all species). The resource was affected by the "Nino in 1982-1983.

Processing of these species, begun in 1950, has been the backbone of the fishing industry. But anchoveta's stocks were greatly affected by the 'Nino" in 1972-1973 and 1982-1983 causing the industry to collapse in 1983, when the sardine replaced the anchoveta as the main harvest. In 1982-1983, the anchoveta population was reduced and migrated at depths below 100 metres. The population became erratic and uncertain, and spawning was affected. Larvae experienced a high rate of mortality, which showed itself in 1984 when the harvest was only 23000 tons.

Between 1950 and 1972 sardine landings were small. The situation changed radically in 1973. During the unusual oceanographic conditions of 1983, the sardine migrated north to south, seeking the current of Peru and the north of Chile, and paralyzing the processors.

The horse mackerel and mackerel showed a huge biomass with the "Nino'. Horse mackerel concentrated in the south and mackerel in the north. But the situation changed when they migrated to deeper waters. Traditional boats depended on this fishes, 40000 people were affected. Mackerel broadened their range of distribution and were caught in unusual areas.

Harvests of the main demersal species —chilean hake *(Mer/uccious gayi),* yellowfin croaker *(Paralonchorus),* flukes *(Paralichthys),* sharks *(Mustelus),* lorna *(Saena deliciosa)* and false flying fish *(Prionotus stephano phrys)*— surpassed 100000 tons in 1973. In 1978, 300000 tons were landed. It is estimated that the "Nino" in 1972-1973 contributed in a positive way to the increase in harvests.

Artisanal coastal fishing depends basically on species associated with coastal areas. The most important are: cabinsa *(Isacia conceptions),* yellowtails *(Seriolella violacea),* mullets *(Mugil cephalus),* lorna *(Saena deliciosa),* herring *(Ethmidium maculatus),* silverside *(Odonthes regia),* and pintadilla *(Cheilodacty/us).*

The figures show that harvests are stable, increasing from 38000 tons in 1970.

The figures show that harvests are stable, increasing from 38000 tons in 1970. Harvests of lisa were 16000 tons; in 1982 the total capture was 70000 tons. This group was replaced by tropical species such as dolphinfish *(Coryphaena),* sawfish *(Scomberomerus),* skate *(Myliobatis),* and others. Argentines were practically exhausted, affecting artisanal fishing.

Captures over the last 15 years of crustaceans species fluctuated between 1000 and 2000 tons. They increased to 10000 tons in 1983, as a result of the unusual appearance of titi shrimp (Xiphopenaeus riveti). These have natural ecological niches in the north, but they moved south to the northern coast of Chile. Harvests of this shrimp increased by 60% (6000 tons), due to the high temperatures. The warmer waters also favoured the appearance of a species of crab (Euphylax robustus), which caused damage to artisanal fisheries.

The mollusk group is comprised by species such as razor clams *(Mesodesma),* clams *(Semele gari),* mussels *(Aulacomia),* abalone *(Concholepas concholepas)* that suffered drastic mortality rates, even though total harvests were not greatly changed. The concha de abanico *(Argopecten purpuratus)* did attain high levels of reproduction, as seen in an increase in landings from 1 000 tons to 10000 tons in 1983. Weather changes could cause mobile shellfish to migrate to temperatures more favourable to their life cycles (hypothesis of gradual change).

The massive elimination of macrocystis favoured green, brown and red algae- Since 1972, harvests have run between 100 and 300 tons. Algae and mobile organisms have the alternative of adapting to new oceanographic conditions. Spores and/or larvae probably find more favourable areas.

Guanos are birds closely linked to the anchoveta. Three species are found: guanay *(Phalacrocorax bouganvillei),* piquero *(Sula variegata)* y pelicans *(Pelecanus occidentalis),* which have high morality rates. In 1982 and 1983 their reproductive cycles were upset. The population was reduced to 300 000 in 1983, due to the loss of the anchoveta, their basic food source.

The mammals species as chusco *(Otaria),* and fino *(Arctocephalus)* species suffered high mortality rates due to a lack of food for adults. Therefore, they rejected their own young. The Brydae whale was absent from the northern area, which is its normal habitat.

The positive abnormalities of the 1982-1983 Nirio (2 to 4.5 'C) introduced substantial changes into the migratory patterns of economically important species (mollusks, crustaceans, et al.). Anchoveta was not harvested and disappeared. Specimen that were studied showed changes in their physiological conditions and low fat content. Harvests dropped from 325145 tons in 1981 to 7696 tons in 1983. The same happened to horse mackerel and mackerel.

Conclusion

The panorama of pollution described here and the effects of the "Nino" as a parameter of what could happen on a large scale with foreseeable weather changes point to the need for environmental policies governing the extraction of resources that are clear and coherent with regional needs. This means forgetting about the macro concepts into which many of our countries fell when they became net exporters of fish-meal. From the total catch for Latin America and the Caribbean (97.5% to maritime fishing and 2.5% to continental fishing) 75% goes to the production of fish-meal and oils, 18.75% to exports and only 6.25% is used as a food source for the region. This is a serious situation, given that today more than 70 million people in Latin America and the Caribbean are malnourished or simply die of hunger.

When allowable limits are set for hydrocarbon-based pesticides, heavy metals, sewage, etc., the senseless practice is followed of dumping gradually to stay within those limits, but without taking into consideration the accumulative effect. In a short time, we could be without fauna. Also accumulations of mercury and other metals can become directly incorporated in cell structures. The operative concept should not be a limit, but rather human health and the conservation of ecosystems. We do not live in a clean environment in the southeast Pacific. We have little consciousness of environmental quality, and little is done politically and legally to preserve the environment. The expected climatic changes, over which scientific experiments have been performed (by Canada's Pacific biological station), will severely affect fishing areas, and the "Nino" confirms that in practice.

Skeptics perhaps suspect that the effects of the rise in temperature around the world could be limited to move-

ments of stocks of species in the oceans, benefitting the reserves of some countries to the detriment of others. According to Russek (1990), nobody benefits from global warming. It is impossible to predict the consequences of overall changes that a warming of the' seas will provoke in the flow of organic m and energy. Poland's Institute of Maritime Fisheries determined that fish stocks will diminish throughout the world, except at the poles. As Russek shows (1990, op.cit.), scientists hay concentrated their efforts on the repercussions of the greenhouse effect on land. It is urgent that scientists and government agencies that deal with the oceans and fisheries carry out investigations to determine the impact of that threat.

Fishworkers, their trade unions and organizations have an important function to fulfill with respect to disseminating information about the environmental threat to the oceans, not only because there is a risk for many communities and jobs, but also because it is the largest renewable resource on earth. The solution and the task should be clear: strict environmental controls have to be established in order to prevent the seas from being poisoned. The production of greenhouse gases has to be reduced. Fishworkers, trade unions and organizations have to join their voices to the growing worldwide campaign to achieve these objectives. The threat to the oceans is the same that threatens the whole planet.

The United Nations Conference on the Environment and Development is approaching. Already banners are being raised in defence of a development now called sustainable. We need a strong and precise declaration in which worldwide, regional and individual obligations are clearly stated, to make this planet what it once was. Nature is giving clearer and clearer signs that it is being misused: temperature rises, reduction the ozone layer, greenhouse effect, floods, droughts, reduction of agricultural land and fishery resources, recurrent and new diseases.

The only thing left to us to do with regards the relation between humankind and the planet is to reason well and on time, or our blindness will lead to even worse consequences. We already have enough evidence of what our irrational behaviour is leading to.